Analysis of Occupational Health and Safety (OHS) on the Cable Tray Support Farming MSP Fabrication Project Using the Hazard Identifications and Risk Assessment (HIRA) and Hazard and Operability (HAZOP) Methods

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ABSTRACT

PT. Swadaya Graha is a company in Gresik City which operates in the steel fabrication sector. One of the collaboration projects that has been completed by PT. Swadaya Graha with PT. Triraya is a cable tray project. When working on a project, work accidents are certainly not spared. Based on the work accident report of PT. Swadaya Graha, from February 2023 to May 2023, had several work accidents on the cable tray construction project. One of these work accidents results in minor injuries and burns. This research was created to minimize the occurrence of work accidents and know the potential dangers of working on a cable tray project so that it can appeal to workers to remain alert and always be careful when working on project work. Using the Hazard Identifications and Risk Assessment (HIRA) and Hazard and Operability (HAZOP) methods, this research found potential sources of danger in the cable tray project work. This research produced 35 potential hazard findings with 5 dominant potential hazards (hazards with the highest level value) and several corrective actions, such as complying with the SOP that has been set, which may be beneficial for the company.

Keywords: Work Accidents, Potential Hazards, Cable Tray, HAZOP, HIRA

Introduction

Occupational Health and Safety (OHS) prevents accidents, disability, and death due to accidents at work[1]. Safety Work (safety) is the safety of workers, and whether they are using a machine, aircraft, work tools, or processing processes, the workplace and environment are also guaranteed[2]. Occupational health and safety are critical to implement in all areas of work without exception because implementing OHS can prevent and reduce the risk of occurrence of accidents[3].

For example, work accidents and health problems often occur when implementing the cable tray project, a big concern for steel fabrication companies. The impact is an increase in company budget expenditure. The importance of occupational health and safety is recognized in developing project implementation in steel fabrication companies, which involves company management, workforce, technical equipment, and materials. Therefore, Occupational Health and Safety issues should not be ignored[4] [5]. A risk management pattern is needed to reduce or even eliminate hazards that can result in workplace accidents, which includes hazard mitigation, potential hazard analysis, risk assessment, risk control, and monitoring and evaluation. The goal is to achieve the target of zero accidents[6]. One of the efforts to reduce work accidents includes facilitating the use of Personal Protective Equipment (PPE) such as safety shoes, masks, ear plugs, helmets and gloves for each worker[7].

PT Swadaya Graha is a service company founded by PT Semen Gresik (Persero), Tbk. This company is engaged in steel construction and fabrication from February 2023 to May 2023, PT. Swadaya Graha with PT. Triraya is working on a cable tray project. The cable tray project is a collaboration project between PT. Swadaya Graha with PT. Triraya, the construction itself took 4 months. The cable tray is a piece of equipment that functions as a cable installation route to protect from environmental factors or overheating problems caused by heat buildup. In the process of working on the cable tray project, work accidents are certainly not spared, as has been obtained from data from interviews with Occupational Health and Safety (OHS) staff[19]. One of the most dominant accidents in working on a cable tray project is stroom stung. It can cause minor to severe injuries to workers. Reducing the occurrence of work accidents, it is necessary to conduct research using the Hazard and Operability Study (HAZOP) and Hazard Identification and Risk Assessment (HIRA) methods. This research aims to determine the potential dangers that exist during the cable tray project work, to find out the dominant potential
dangers with the highest values through risk assessment calculations using the Hazard Identification and Risk Assessment (HIRA) method, and to provide recommendations for improvements using the Hazard and Operability Study (HAZOP)[12] [20].

Research Methods

Research Concept
The research was conducted on the cable tray project at PT. Swadaya Graha. This research was conducted for 4 months, namely February 2023 to May 2023. This research aims to identify and assess hazards and provide risk control for dangers that occur during cable tray project work. This research uses the Hazard and Operability Study (HAZOP) and Hazard Identification and Risk Assessment (HIRA) methods.

A hazard and Operability Study is an effort to identify the dangers of a processing unit if it deviates from what it should be. Hazops is a very systematic, thorough and complete technique. HAZOPS was initially developed only for industry but can also be used for other activities[8]. You can use the Hazard and Operability Study (HAZOPS) method to identify and carry out potential hazard analysis. This method implements risk management and ensures the direction of occupational safety and health within the company[9]. Based on the results of research conducted by Restuputri & Sari (2015), HAZOP itself systematically works by looking for various causal factors that allow work accidents to occur and determining adverse consequences as a result of deviations as well as providing recommendations or actions that can be taken to reduce the impact of identified potential risks[10] [11].

Hazard Identification and Risk Assessment (HIRA) is a method or technique for identifying potential work hazards by defining the characteristics of hazards that may occur and evaluating the risks that arise through risk assessment using a risk assessment matrix[16] [17]. Hazard Identification and Risk Assessment (HIRA) is a method of identifying work accidents, and risk assessment is one of the crucial points for implementing the Occupational Safety and Health Management System[18].

Research Variable
Several risk variables were obtained in this study. These risk variables are literature studies, field observations, and interviews with Occupational Health and Safety (OHS) staff. These will be used as assessment material when distributing the questionnaire to respondents. The respondent in this study was the head of the Occupational Health and Safety (OHS) division. Meanwhile, the statement of potential hazards that must be assessed for likelihood and consequences by the head of the Occupational Health and Safety (OHS) division amounts to 35 potential hazards.

Research Steps
1. Identify potential hazards through literature studies, field observations, interviews with Occupational Health and Safety (OHS) staff, and distributing questionnaires to the head of the Occupational Health and Safety (OHS) division.
2. Data analysis included distributing questionnaires, assessing and determining risks using the Hazard Identification and Risk Assessment (HIRA) method, and determining risk controls using the Hazard and Operability Study (HAZOP) method.

Results and Discussion
Identification of Potential Hazards and Risk Assessment Using the Hazard Identification and Risk Assessment (HIRA) Method
Potential hazards are identified to determine the existing hazards in the cable tray project work. This identification was done through field observations and interviews with resource persons, namely the head of the Occupational Health and Safety (OHS) division and the Occupational Health and Safety (OHS) staff. The results of these interviews produced 35 hazard findings, which will then be assessed in the form of a questionnaire by the head of the Occupational Health and Safety (OHS) division.

The risk assessment is carried out after the head of the Occupational Health and Safety (OHS) division fills out a questionnaire. The K3 division head answered by selecting a value from numbers 1 to 5 in each column of likelihood and severity[21]. In carrying out hazard analysis using Hazard Identification and Risk Assessment (HIRA), likelihood and consequences criteria are needed to carry out risk assessments. These criteria can be seen in the table[22]. What is meant by likelihood criteria is the criteria used to calculate the possibility of an accident
risk based on the frequency per unit of time (day, month, year)[23]. Meanwhile, the consequences criteria are risk impact criteria, which are classified based on the severity of the impact of risk events that may occur[24].

<table>
<thead>
<tr>
<th>Level</th>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rarely happening</td>
<td>It's conceivable, but not only in extreme cases Occurs less than once in 10 years</td>
</tr>
<tr>
<td>2</td>
<td>Slight chance of it happening</td>
<td>Hasn't happened yet but may appear at one time 1 time in a span of 10 years</td>
</tr>
<tr>
<td>3</td>
<td>Might happening</td>
<td>It should happen and may have occurred here or elsewhere Happened 1 time in 5 years to 1 time every year</td>
</tr>
<tr>
<td>4</td>
<td>Most likely happening</td>
<td>It can quickly occur and may appear under circumstances that happen most Occurs more than 1 time per year to 1 time per month</td>
</tr>
<tr>
<td>5</td>
<td>Almost certainly will happen.</td>
<td>Happens frequently, is expected to appear under certain circumstances, and happens most Occurs every month or more than once per month</td>
</tr>
</tbody>
</table>

In assessing the risk severity level using the risk matrix table, the likelihood and consequences values obtained are processed using the risk matrix table to determine the level of risk severity. Each colour means a difference in score risk value or risk level[25].

<table>
<thead>
<tr>
<th>Level</th>
<th>Criteria</th>
<th>Severity of injury</th>
<th>Working days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not significant</td>
<td>The incident didn't cause injury and did not result in loss of material</td>
<td>No lost days of work</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>The incident caused minor injuries that could have been treated with first aid and resulted in material losses.</td>
<td>Lost days of work on the same day</td>
</tr>
<tr>
<td>3</td>
<td>Medium</td>
<td>The incident caused serious injury, required hospital treatment and resulted in losses of enough material.</td>
<td>Lost workdays under 3 days</td>
</tr>
<tr>
<td>4</td>
<td>High</td>
<td>The incident caused serious injury, resulting in permanent defects and major material losses.</td>
<td>Lost day of work more than 3 days and or more</td>
</tr>
<tr>
<td>5</td>
<td>Disaster</td>
<td>The incident caused the victim to die and caused a huge loss</td>
<td>Lost days of work forever</td>
</tr>
</tbody>
</table>

In assessing the risk severity level using the risk matrix table, the likelihood and consequences values obtained are processed using the risk matrix table to determine the level of risk severity. Each colour means a difference in score risk value or risk level[25].

<table>
<thead>
<tr>
<th>Scale</th>
<th>Likelihood</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Where:

Red indicates that the consequence is at extreme risk, yellow indicates that the result is at high risk, green indicates that the consequence is at moderate risk, and blue means that the result is at low risk[26].

determine the risk value, which can be obtained by multiplying likelihood and consequence. The results can be seen in the table below.

<table>
<thead>
<tr>
<th>No</th>
<th>Work Process</th>
<th>Potential Hazard</th>
<th>L*</th>
<th>C*</th>
<th>L*C</th>
<th>Risk Level</th>
</tr>
</thead>
</table>

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1. Marking Process
- Struck to scratches from materials: 3, 3, 9 (High)
- Be squeezed of materials: 3, 3, 9 (High)
- Falling of materials: 3, 2, 6 (Medium)
- Be pressed down of materials: 2, 2, 4 (Medium)
- Stumble of materials: 1, 2, 2 (Low)

2. Cutting Process
- Exposed to smoke and dust: 3, 3, 9 (High)
- Hit by sparks: 3, 4, 12 (Extreme)
- Tripping over the remaining cutting material: 3, 3, 9 (High)
- Stroom stung: 3, 5, 15 (Extreme)
- Injured (scratched): 3, 3, 9 (High)

3. Machining Process
- Exposed to gram splashes: 3, 4, 12 (Extreme)
- Injured (scratched): 2, 2, 4 (Medium)
- Wildfire: 3, 3, 9 (High)
- Stroom stung: 4, 4, 16 (Extreme)
- Hit by a spark: 4, 3, 12 (Extreme)

4. Setting Process
- Material collapses: 3, 3, 9 (High)
- Hit by a hammer: 4, 3, 12 (Extreme)
- Pinched: 4, 3, 12 (Extreme)

5. Welding Process
- Stroom stung: 4, 4, 16 (Extreme)
- Exposure to welding light: 4, 3, 12 (Extreme)
- Noise: 4, 4, 16 (Extreme)
- Exposed to smoke and dust from welding: 4, 3, 12 (Extreme)
- Exposed to welding sparks: 4, 3, 12 (Extreme)

6. Painting and Sandblasting Process
- Exposed to painting mist: 4, 3, 12 (Extreme)
- Exposed to paint splashes in the eye area: 4, 3, 12 (Extreme)
- Exposed to paint or thinner: 4, 3, 12 (Extreme)
- Exposed to silica sand dust: 4, 3, 12 (Extreme)
- Compressor explosion: 3, 3, 9 (High)
- Exposed to compressor vapour blast: 3, 4, 12 (Extreme)
- The pressure used is too high: 4, 4, 16 (Extreme)

7. Packing and Delivery Process
- There are no sirens or warning signs: 3, 2, 6 (Medium)
- Pinched by material: 3, 2, 6 (Medium)
- Sling belt or wire sling broken: 3, 2, 6 (Medium)
- Forklift tire leak: 2, 2, 4 (Medium)
- Overcapacity: 2, 2, 4 (Medium)

From the analysis results in Table 4, it was found that 5 variables had values in the highest extreme category. For more details, see table 5.

Table 5. Dominant Risk Variable

<table>
<thead>
<tr>
<th>No</th>
<th>Work Process</th>
<th>Potential Hazard</th>
<th>L*C</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cutting process</td>
<td>Stroom stung</td>
<td>15</td>
<td>Extreme</td>
</tr>
<tr>
<td>2.</td>
<td>Machining process</td>
<td>Stroom stung</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>3.</td>
<td>Welding process</td>
<td>Stroom stung</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>4.</td>
<td>Welding process</td>
<td>Noise</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>5.</td>
<td>Painting and Sandblasting process</td>
<td>The pressure used is too high</td>
<td>16</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Hazard Risk Analysis, Hazard Sources Analysis, and Dominant Risk Control Using the Hazard and Operability (HAZOP) Method

Hazard risk and hazard sources were obtained from interviews with the head of the Occupational Health and Safety (OHS) division from PT. Swadaya Graha[13]. Hazard sources can come from human negligence, production processes, materials and equipment[15]. Hazard risk analysis and hazard sources can be seen in the table below.
Table 6. Hazard Risk Analysis and Hazard Sources Analysis of Dominant Hazard Using the Hazard and Operability Study (HAZOP) Method

<table>
<thead>
<tr>
<th>No.</th>
<th>Work Process</th>
<th>Potential Hazard</th>
<th>Hazard Risk</th>
<th>Hazard Sources</th>
<th>L*C</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cutting process</td>
<td>Stroom stung</td>
<td>Electric shock, burns</td>
<td>Human negligence, equipment</td>
<td>15</td>
<td>Extreme</td>
</tr>
<tr>
<td>2.</td>
<td>Machining process</td>
<td>Stroom stung</td>
<td>Electric shock, burns</td>
<td>Human negligence, equipment</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>3.</td>
<td>Welding process</td>
<td>Stroom stung</td>
<td>Electric shock, burns</td>
<td>Human negligence, equipment</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>4.</td>
<td>Welding process</td>
<td>Noise</td>
<td>Hearing disorders</td>
<td>Production process</td>
<td>16</td>
<td>Extreme</td>
</tr>
<tr>
<td>5.</td>
<td>Painting and Sandblasting process</td>
<td>The pressure used is too high</td>
<td>Material damage</td>
<td>Equipment</td>
<td>16</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Next is the dominant risk control process. Risk control is used to anticipate and also reduce the occurrence of work accidents[14]. Dominant risk control will be carried out on 5 risk variables in the extreme category, including:

1. The same dangerous variable exists in the cutting, machining and welding processes, namely stroom stung. The appropriate control measures are to use complete APD, especially safety gloves, be more careful in areas prone to work accidents, and comply with the established SOP.
2. In the welding process, there is a dangerous variable: noise. The appropriate control action is to use complete APD, especially headphones, and comply with the established SOP.
3. There is a dangerous variable in the painting and sandblasting process, namely, the pressure used is too high. The appropriate control action is to use complete APD, especially headphones, and comply with the established SOP.

Conclusion

Based on the results of the research and discussion that the author has carried out, the following conclusions can be drawn: Based on the analysis of identifying potential hazards in the cable tray project work, 35 potential hazards were obtained. Five potential hazards in the marking process, 5 potential hazards in the cutting process, 5 potential hazards in the machining process, 3 potential hazards in the setting process, 5 potential hazards in the welding process, 7 potential hazards in the painting and sandblasting process, and 5 potential hazards in the process packing and shipping. The most common sources of hazards in cable tray project work include human negligence, production processes and equipment. Control measures for discovered and adjusted hazards include using complete and appropriate PPE, adhering to established SOPs, and being more careful when in work accident-prone areas.

Even though this research provides relatively strong evidence in finding potential hazards, hazard risks, and sources of hazards in cable tray projects, carrying out further research by examining other collaborative projects to find more potential hazards and recommendations for improvements will be much better because by doing this In this way, workers will be much more protected from work accidents. Adding 1 research method on occupational health and safety, such as Job Safety Analysis (JSA) or Hazard Identification, Risk Assessment, and Determining Controls (HIRADC), can also provide readers with broader knowledge and insight into the world of occupational health and safety.

References


